

E-learning Training for Spanish Compulsory Secondary Education Teachers to Use SDI as an ICT Educational Resource.

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Abstract

The fast development of the Information and Communication Technologies (ICT) and their progressive implementation in the educational field have led to significant changes in teaching and learning methodologies and have made the use of new teaching resources in the classroom a top priority.

ICT offer a huge amount of educational resources. In this context Spatial Data Infrastructure (SDI) is available at all levels (from global to local) and presents different possibilities to be used as ICT teaching resources. However, the use of SDI in Spanish Compulsory Secondary Education ('Educación Secundaria Obligatoria' – ESO) requires teachers to be trained and acquainted with the features and applications of this technological tool.

In order to provide the adequate teacher training, both theoretical and practical, three e-learning courses have been designed, developed and implemented for three different areas of Spanish ESO (Social Sciences, Sciences of Nature and Technology). In these courses we propose the use of SDI as ICT teaching resources. The courses present a theoretical lesson which includes: (a) an overview and the most important concepts in SDI and (b) methodological proposals which approach ESO curricula using SDI as a teaching resource.

In this paper we present the implementation and evaluation stages, showing the results of the first edition of the courses in which teachers from several Latin American countries took part. These results have enabled us to obtain information about the opinion of secondary teachers regarding the possibility of using SDI to teach Social Sciences, Sciences of Nature and Technology curricula.

Keywords: Information and Communication Technologies (ICT), ICT educational resources, Spatial Data Infrastructure (SDI), Compulsory Secondary Education ('Educación Secundaria Obligatoria' – ESO)

1. INTRODUCTION

The advances of the Information and Communication Technologies (ICT) help to add new perspectives to the Spatial Data Infrastructure (SDI) world, enabling access and interchange at different levels of updated geographic information through the Internet. This has raised the interest not only of professionals related to or trained in the topic of geographic information but also of different public and private sectors of society. The educational sector has not remained outside; on the contrary it is representing one of the most favourable spaces for dissemination of the potentialities and uses of SDIs.

If we consider that the ICT enable new forms of accessing, generating and communicating information and knowledge, favouring the creation of active environments and promoting a dynamic and constructive learning – “to do” and “know how to do” (Cabero, 2007) – and if we think that the SDI respond to the characteristics of the ICT, their utilisation in the educational context offers possibilities worth being known, assessed and disseminated.

The utilisation of the SDI within the educational context implies to assign them a role in the process of teaching-learning that corresponds to the means /resource with which the contents will be taught; when an educational purpose is granted, the resources become educational. In this process the SDI could be one of the educational resources to address contents related to geographic information and ICT. Yet since we are dealing with an educational resource closely related to the ICT, that relationship has been made explicit with a wider concept: *“ICT educational resource.”*

To reveal and discover the possibilities offered by the SDI as an ICT educational resource requires training of the teaching staff to address those contents related to geographic information and ICT. With the purpose of giving an answer to this training, three e-learning courses have been designed, developed and implemented for the subjects of Social Sciences, Sciences of Nature and Technologies, of the Compulsory Secondary Education (‘Educación Secundaria Obligatoria’ – ESO) of Spain.

In this work the background giving rise to the proposal of training of the ESO teaching staff is presented in the first place. In the second place the objectives and the methodology that has resulted in the implementation of the first edition of the e-learning courses are explained. In the third place we collect the results of this first edition through some descriptive and statistical analyses that have allowed getting a first approach to the vision and idea of the teaching staff regarding the possibilities of using the SDI as an ICT educational resource. Finally conclusions are presented briefly and some of the future research activities are mentioned.

2. BACKGROUND

2.1. Project

The e-learning courses for the ESO teaching staff arise in response to one of the project lines of the SDI Working Group in Spain (GTIDEE): Popularisation and dissemination of the SDI paradigm, especially in Spain with specific reference to the subproject *“SDI as educational resource in the Compulsory Secondary Education”*,

recognising the need to bring the SDI closer to education and contribute to their dissemination. Within this context the project *E-learning training for the Compulsory Secondary Education teaching staff to use SDI as an ICT educational resource*” was brought up through a Collaboration Agreement between the National Geographic Institute of Spain (IGN) and the Technical University of Madrid (UPM). As a result of the project, three e-learning self-training self-learning courses were designed and developed for the teaching staff.

2.2. SDIs in the Compulsory Secondary Education

When opting for the Internet as support, SDI became a potential educational resource to contribute to the achievement of the objectives related to the ICT, fostering the development of the different basic competences, especially the competence related to treatment of information and the digital competence (Gonzalez, 2009). This is directly related to Ley Orgánica 2/2006 whose Article 23. Objectives. Chapter III, states that ESO will contribute to the preparation of the pupils in the field of ICT. *“To develop basic skills in the utilisation of information sources to critically acquire new knowledge. To acquire a basic preparation in the technology field, especially information and communication.”*

The digital competence *“...consists of having the capability to search for, obtain, process and communicate information and to turn it into knowledge. It incorporates different abilities, from access to information to transmission in different supports, including the utilisation of the information and communication technologies as an essential element to get informed, learn and communicate”*. (Annex I, Basic Competences, Real Decreto 1631/2006).

The SDI as an ICT educational resource in the classroom allow offering to the pupils another information source through the new technological tools that serve as an instrument to transform information into knowledge, establishing relationships, analysing, understanding, inferring and synthesising the information to generate their own knowledge. Therefore the SDI not only represent a way of bringing the pupils closer to the ICT but they also represent an important information source, specifically geographic information, that they can transform into knowledge if applied to the common basic contents of certain subjects of the ESO curriculum (Gonzalez, 2008).

3. OBJECTIVES AND METHODOLOGY

3.1. Objectives

The following general objectives were raised as a guide of the process that finished with the development of the first edition of the e-learning courses:

- Design and develop e-learning courses for the ESO teaching staff with the purpose of disseminating the SDI within the educational scope.
- Offer didactic proposals to the teaching staff to use SDI as an ICT educational resource in the ESO subjects addressing Geographic Information and ICT related contents.
- Assess and analyse the results of implementation of the courses gathering a first view and opinion of the ESO teaching staff concerning the utilisation of SDI as an ICT educational resource.

3.2. Methodology

The methodology was organised on the basis of the *Addie Instructional Design Model* which is made up of five phases: Analysis, Design, Development, Implementation, and Evaluation.

Next a brief reference is made to the three first phases (Analysis, Design and Development), to set in a context the two last phases that are object of interest in our work: Implementation and Evaluation

1) Analysis phase

This phase was divided into the following tasks giving as a result an Analysis Phase Report:

- a) Analysis of the Spanish legislation concerning the Compulsory Secondary Education. In the first place a revision of the objectives and basic competences was carried out to identify how to contribute to the achievement of those objectives and competences using the SDI as an ICT educational resource. In the second place the ESO Common Basic Contents of the subjects of interest for the project were analysed: Social Sciences, Sciences of Nature and Technology, of the Real Decreto 1613/2006 of December 2006, by which the minimum teaching corresponding to the Compulsory Secondary Education of Spain is established.
- b) With the purpose of knowing the context, i.e. ESO, in which the courses will be implemented, the educational resources available in the Web to address Geographic Information and ICT related contents were evaluated, and concurrently a revision of the textbooks currently used in Social Sciences, Sciences of Nature and Technology was carried out.
- c) We contacted a high school and meetings with Social Sciences, Science of Nature and Technology teachers were established; their needs were identified and they were contrasted with our proposal, looking at the feasibility of using SDI as an ICT educational resource.

2) Design phase

This phase was divided into the following tasks giving rise to a Design Phase Report:

- a) In this phase the results of the analysis phase were used and the strategies were set, giving way to the development phase: times, chronograms, task distribution, etc.
- b) The teaching-learning model of the courses was indicated and a brief description was made of different didactic proposals that use ICT being implemented in the classroom, contributing to the digital competence.
- c) The selection of the conceptual contents was carried out from the analysis made of the ESO Common Basic Contents (Real Decreto 1613/2006, of December 2006) of the subjects of interest for the project: Social Sciences, Sciences of Nature and Technology. Finally, the theoretical-practical contents for each course were specified.

3) Development phase

This phase was divided into the following general tasks:

- a) Development of the theoretical-practical contents and the instructional guide with indications of structure and sequence of the screens, with specifications of the media to be used (audio, graph, video, etc) and the corresponding instructions for the designer.
- b) Definition of the visual image of each course. Graphic design of the screens specified in the instructional guide.

- c) Creation of the content packages based on the SCORM 1.2 specifications to be implemented in the MOODLE Learning Management System.
- d) As a result of this phase, three 10-hour courses were obtained for each of the following subjects: Social Sciences, Sciences of Nature and Technology. The courses are made up of:
 - A common theoretical lesson of “Introduction to SDI”, of 2 hours.
 - Specific didactic proposals for each subject in which contents are addressed using the SDI as an ICT educational resource.

4) Implementation phase

This phase comprised the following tasks:

- a) Implementation of the courses in the *MOODLE* Learning Management System: EduGEO Virtual Classroom <http://138.100.62.244>

Each course was organised in four items located in the Diagram of Themes in the following order. The course corresponding to the subject of Social Sciences is presented as an example:


Figure 1: EduGEO Virtual Classroom: Courses implemented



- Presentation of the course, forums, guide and survey 1: “Training and use of ICT.”

Figure 2: Course presentation

Diagrama de temas



Infraestructuras de Datos Espaciales (IDE) como un recurso educativo TIC

IDE para Ciencias Sociales

1

- Presentación del curso
- Novedades
- Foro para comentarios, opiniones, mensajes, ...
- Guía del Alumno
- Completar el perfil

Encuesta: Formación y uso de las TIC

- Materials corresponding to the Theoretical Lesson “Introduction to the Spatial Data Infrastructures (SDI)”, self-assessment questionnaire and opinion surveys.

Figure 3: Theoretical lesson

2

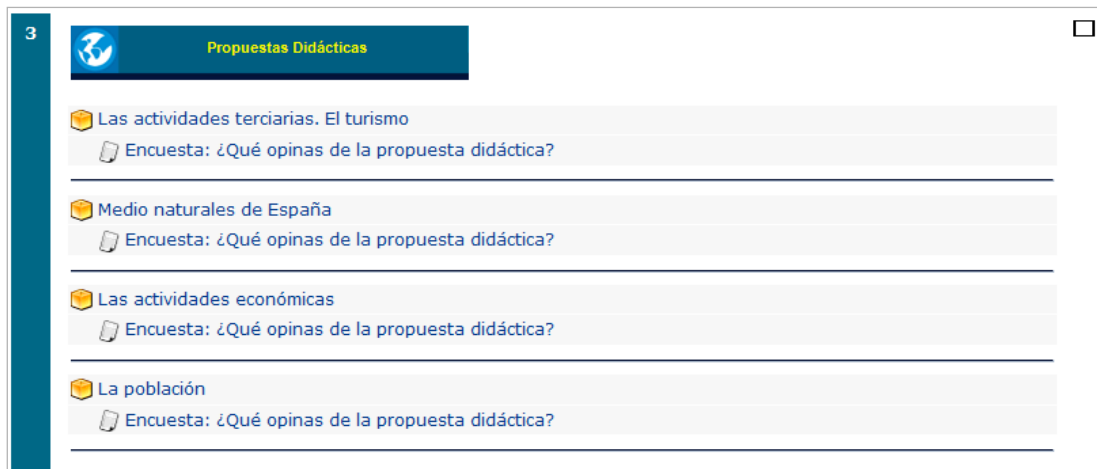
Lección teórica: Introducción a las IDE

Lección

- Cuestionario
- Encuesta: ¿Qué opinas de la lección?

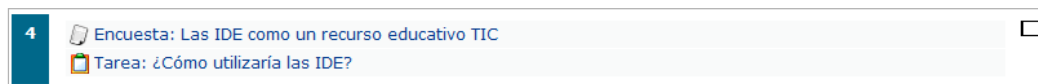
- SCORM content packages with the didactic proposals and their corresponding link to the opinion survey.

Figure 4: Teaching proposals



- Survey to get the opinion of the teaching staff concerning the SDI as an ICT educational resource, regarding the possibilities offered to use in the classroom.
To finish the course, as an optional task, the teachers are invited to present a general proposal about how they would use the SDI in their subject.

Figure 5: Survey and task



b) Design and development of questionnaires:

The following questionnaires for the opinion surveys were designed and developed for the purpose of evaluating the contents and materials of the e-learning courses:

- Questionnaire “*Training in ICT*”, to estimate the degree of training of the participating teachers in ICT.
- Questionnaire “*Theoretical lesson*”, to evaluate the theoretical lesson “*Introduction to the Spatial Data Infrastructures*”.
- Questionnaire “*Didactic proposal*”, to evaluate the didactic proposals presented as an example for each subject (Social Sciences, Sciences of Nature and Technology).
- Questionnaire “*SDI as an ICT educational resource*”, to get the opinion of the teachers regarding the possibilities and feasibility of utilisation of SDIs as an ICT educational resource.

c) Validation of questionnaires

The validation of the different questionnaires corresponding to the opinion polls was carried out by a group of students of the PhD course “*Introduction to the Spatial Data Infrastructure*”. This course is being given as a part of the PhD Program in Geographic Engineering of the School of Surveying, Geodesy and Cartography of the Technical University of Madrid.

d) Questionnaire implementation

The questionnaires were implemented in an MySQL type DataBase Management System (DBMS) starting from the creation of tables.

Connection between the database and the forms allows the correct insertion of the answers encoded in the database by the users, which is carried out through the PHP programming language, using for the occasion a specific library (API) for MySQL called mysql.so. The lodging and online access to the set of forms has been carried out in the *Joomla System of Content Management*.

e) Call for participants

The call for participants was made through dissemination of the courses by different media, both directly and indirectly.

- Contact with high schools of the Community of Madrid,
- Dissemination in social networks for teachers:
 - Network of professors in Malaga:
<http://redcepmalaga.ning.com/main/authorization/signIn?target=http%3A%2F%2Fredcepmalaga.ning.com%2F>
 - Innovative professors network:
<http://profesoresinnovadores.ning.com/>
 - Internet classroom network:
<http://internetaula.ning.com/>
 - Worldwide professors network:
<http://profesoresdelmundo.ning.com/forum>
 - Educational technology teaching network:
<http://redtecnologiaeducativa.ning.com/>
 - Latin America and the Caribbean teachers network:
<http://docenteslatinoamericanos.ning.com/forum/topics/investigaciones-1>

5) Evaluation phase

a) Opinion surveys

The courses were developed within a period of two weeks and the evaluation of their contents and materials was made through the different opinion surveys.

The answers of the opinion surveys were collected through the database system and exported first of all to an Excel format to make a descriptive analysis of the results and get an overview. In the second place the data were exported to carry out some initial analysis with the SPSS statistical software.

b) Participation rating

The number of teachers interested in taking the different courses was high but the actual participation rating was not as expected. This was clearly reflected on the much lower number of answers than had been expected.

The records of admission to the *Aula Virtual* (Virtual Classroom) show that during the first few days an important number of pupils were admitted, but later, as the days passed the number dropped. It was also observed that during those first days the pupils made a brief revision of the majority of the available materials. On the other hand, since the situation was new and

unknown for everybody, the lack of a tutor resolving doubts could have been one of the causes determining withdrawal. It should also be stressed that the participation of the professors was in the sense of a very wide collaboration when considering that taking the course did not grant them any economic reward and the certification that will be given to them will be in appreciation to their collaboration in the pilot test, since the courses have not received official recognition as yet.

4. RESULTS

The number of answers to the different opinion surveys included in the course was lower than expected. However, the results obtained will be used as a reference for improvement actions and implementation of new training proposals.

Next a brief descriptive analysis is made considering some of the results obtained in two of the opinion surveys.

a) Survey: *“Training and use of the ICT”*

From this survey, information is obtained related to both the characteristics of the surveyed population (age, sex, education) and training and use of the ICT which may somehow influence their opinion regarding the use of the SDI.

On a total of 42 surveyed professors:

- 52 % has been in service for less than 10 years.
- About 90% of the surveyed professors have taken ICT courses, seminars or training workshops.
- 64% participates in some project related to use or application of ICT in the classroom.
- Regarding access and use of ICT: 83% has easy access to computer resources in the high school, yet only 23% uses the computer with the pupils.
- The ICT educational resources used are varied, the highest percentages, between 90% and 95%, register the use of e-mail, text processors, educational portals and webs related to the subject contents.
- Regarding the educational resources being used less (between 20% and 23%) are the Webquests, databases and digital blackboards.
- In general there is a favourable attitude toward ICT. 83% to 92% considers that DEFINITELY YES, if ICT contributed to improve the teaching-learning process and increase pupils' interest, they would be willing to participate in ICT related projects and to use different ICT educational resources to impart their subject.

b) Survey: *“SDI as an ICT educational resource”*

On a total of 32 surveyed professors:

- 69 % considers that DEFINITELY YES, the SDI, as an ICT educational resource, has a possibility of being used in the classroom, while the remainder 21% considers PROBABLY YES.
- As far as the SDI being an innovative ICT educational resource, 81% states DEFINITELY YES, while the remainder 19% considers PROBABLY YES.
- 71% would DEFINITELY use the SDI to address contents of their subject while the remainder 29% PROBABLY YES would do it.

- 65% considers that DEFINITELY YES they need training in SDI while 25% states that PROBABLY YES they would need it and 10% is UNDECIDED.

Some initial analyses of the results have been made using the SPSS statistical software that are exposed below.

The scales used in the questionnaire correspond to different alternatives or points in the Likert scale which consists of a number of items under the form of statements or judgements that allow measuring attitudes or reactions (favourable, unfavourable, positive or negative) of the surveyed people. The selected scale is as follows: (5) Definitely yes (4) Probably yes (3) Undecided (Statement) (2) Probably no (1) Definitely no.

Reliability analysis of the scales was carried out using *Cronbach's Alpha*.

- a) Variables corresponding to the dimension: Attitudes toward the ICT of the Questionnaire #1 (Training and use of the ICT)

Case Processing Summary			
		N	%
Cases	Valid	42	72,4
	Excluded ^a	16	27,6
	Total	58	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics		
	Cronbach's Alpha	
	Based on	
Cronbach's Alpha	Standardized Items	N of Items
,733	,733	4

Item Statistics			
	Mean	Std. Deviation	N
P_04_01	4,83	,377	42
P_04_02	4,83	,377	42
P_04_03	4,86	,417	42
P_04_04	4,90	,370	42

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
P_04_01	14,60	,832	,508	,512	,682
P_04_02	14,60	,881	,425	,491	,728
P_04_03	14,57	,739	,573	,771	,644
P_04_04	14,52	,792	,599	,762	,631

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
19,43	1,324	1,151	4

- a) All the variables of the Questionnaire #4: “SDI as an ICT educational resource”

Case Processing Summary

		N	%
Cases	Valid	32	55,2
	Excluded ^a	26	44,8
	Total	58	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,751	,786	4

Item Statistics

	Mean	Std. Deviation	N
p_01_01_IDE	4,69	,471	32
p_01_02_IDE	4,81	,397	32
p_01_03_IDE	4,72	,457	32
p_01_04_IDE	4,56	,669	32

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
p_01_01_IDE	14,09	1,636	,425	,467	,754
p_01_02_IDE	13,97	1,580	,635	,613	,666
p_01_03_IDE	14,06	1,286	,844	,783	,536
p_01_04_IDE	14,22	1,273	,430	,335	,808

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
18,78	2,370	1,539	4

A thorough analysis of these data shows the low quality of the p_01_04_IDE element, since it presents a low correlation with the whole scale and its elimination would increase the reliability coefficient of the scale in its entirety.

With the element, Cronbach's Alpha is 0.786, and when the element is removed it increases to 0.808 which is within a larger acceptability range. This is acceptable considering that this element corresponds to a question requesting information related to the need of training in SDI as an ICT educational resource while the first three questions are focused on the SDI as an ICT educational resource in their possibilities of classroom utilisation, their innovative nature and their use to address subject contents.

The degree of intensity of the relation between the variables of questionnaires has been measured through the *Pearson's Correlation*, with the following results:

In general a moderate correlation is observed between:

- The utilisation of ICT educational resources increases the pupils' interest in the subject and their contribution to improve the teaching-learning process. The latter also shows a moderate correlation with the statement of using SDI to address the subject contents.
- A correlation is also observed with higher values of intensity, though still moderate for the following elements:
The utilisation of the SDI in the subject and its consideration as an innovative resource.
- An intense correlation, above 0.8, is observed in the following elements: the interest in learning to use different ICT educational resources to impart the subject and the interest in participating or collaborating in educational projects related to ICT utilisation.

Correlations

		P_04_01	P_04_02	P_04_03	P_04_04	p_01_01_I DE	p_01_02_I DE	p_01_03_I DE	p_01_04_I DE
P_04_01	Pearson	1	,657**	,310*	,233	,561*	,429	,655**	,068
	Correlation								
	Sig. (2-tailed)		,000	,046	,138	,024	,098	,006	,803
	N	42	42	42	42	16	16	16	16
P_04_02	Pearson	,657**	1	,155	,233	. ^a	. ^a	. ^a	. ^a
	Correlation								
	Sig. (2-tailed)	,000		,327	,138	,000	,000	,000	,000
	N	42	42	42	42	16	16	16	16
P_04_03	Pearson	,310*	,155	1	,857**	,422	,169	,000	-,080
	Correlation								
	Sig. (2-tailed)	,046	,327		,000	,103	,531	1,000	,767
	N	42	42	42	42	16	16	16	16
P_04_04	Pearson	,233	,233	,857**	1	,383	-,098	-,149	-,139
	Correlation								
	Sig. (2-tailed)	,138	,138	,000		,143	,719	,582	,607
	N	42	42	42	42	16	16	16	16
p_01_01_I DE	Pearson	,561*	. ^a	,422	,383	1	,367*	,628**	,166
	Correlation								
	Sig. (2-tailed)	,024	,000	,103	,143		,039	,000	,363
	N	16	16	16	16	32	32	32	32
p_01_02_I DE	Pearson	,429	. ^a	,169	-,098	,367*	1	,768**	,410*
	Correlation								
	Sig. (2-tailed)	,098	,000	,531	,719	,039		,000	,020
	N	16	16	16	16	32	32	32	32
p_01_03_I DE	Pearson	,655**	. ^a	,000	-,149	,628**	,768**	1	,534**
	Correlation								
	Sig. (2-tailed)	,006	,000	1,000	,582	,000	,000		,002
	N	16	16	16	16	32	32	32	32
p_01_04_I DE	Pearson	,068	. ^a	-,080	-,139	,166	,410*	,534**	1
	Correlation								
	Sig. (2-tailed)	,803	,000	,767	,607	,363	,020	,002	
	N	16	16	16	16	32	32	32	32

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

a. Cannot be computed because at least one of the variables is constant.

So far the results obtained from the analysis carried out within the SPSS statistical software are not conclusive; we will continue carrying out analyses and depending on the results, new strategies will be implemented to confirm or refute them.

In general the results obtained in the courses have been satisfactory considering the interest shown by the participants in the SDI as an educational resource which is reflected on the results obtained in the opinion survey. A high percentage of professors consider that the SDI as an ICT educational resource have great possibilities, in addition to consider them innovative and be willing to use them in the classroom. However, it will be possible to put this into effect if the needs of training in the topic of SDI are covered, as stated by 90% of the professors having participated in the courses.

5. CONCLUSIONS

The methodology used to put into effect the training courses for the ESO teaching staff has allowed acquiring experience in the *ADDIE Instructional Design Model*, which given its flexible nature, was appropriate for achievement of the proposed objectives.

Although the participation rating was not as expected, the first edition of the course has allowed obtaining a first set of results as well as a compilation of information and learned lessons that will allow making adjustments for future training activities in the matter of SDI.

The first analyses of the results obtained in the first edition of the self-training e-learning courses have been made; on the basis of these results we have got an overview of the ideas and opinion of the ESO teachers regarding the possibility SDI offers as an ICT educational resource of an innovative nature, to be used in the classroom.

We will go on carrying out analyses of the data obtained by the opinion surveys in order to draw new conclusions contributing to the improvement of future training proposals in the matter of SDI with a specific orientation toward ESO teaching staff.

The objective is to continue the work of dissemination of the SDI in the ESO context, helping the professors find out the possibilities offered by the SDI as an ICT educational resource to address contents related to Geographic Information and ICT. The implementation of the appropriate strategies for the teachers' training will allow reaching the pupils, so that they will learn about the SDI and with the SDI.

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